Epidemiology Modelling Review Group: consensus statement on COVID-19

Date: 15 September 2021
Introduction

The UK Health Security Agency (UKHSA) Epidemiology Modelling Review Group (EMRG) shares this consensus statement on COVID-19 with acknowledgment to SPI-M-O, who have developed and shared modelling methodologies and contribute model outputs to these combined estimates.

All probability statements are in line with the framework given in Annexe A.

Summary

1. UKHSA’s best estimate for R in England is between 0.9 and 1.1. R is estimated to be between 1.0 and 1.3 for Scotland, 1.0 and 1.2 for Wales, and 0.8 and 1.1 for Northern Ireland (Figure 1). These estimates are based on models¹ fitted to data available up to 13 September 2021, including hospitalisations, deaths, testing, wastewater samples and longitudinal studies, and therefore will not fully reflect the effect of the return of schools in England.

2. Combined estimates² show that the incidence³ is between 37,000 and 69,000 new infections per day in England.

3. R is an indicator that lags by two to three weeks. This inherent lag means that recent fluctuations should not be expected to be consistent with these estimates, and estimates may not represent transmission trends now.

Incidence and prevalence

4. During its most recent week (ending 11 September), the ONS Covid infection survey estimates⁴ that an average of 697,100 people had COVID-19 in the community in England (95% credible interval 650,600 to 743,800). The survey does not include people in care homes, hospitals, or prisons. Estimates from across the 4 nations of the UK are:

- England 697,100 (95% credible interval 650,600 to 743,800)
- Scotland 120,800 (95% credible interval 102,200 to 140,700)
- Wales 49,100 (95% credible interval 38,500 to 61,000)
- Northern Ireland 25,000 (95% credible interval 17,700 to 33,600)

¹ Model estimates are required as quantities such as the Reproduction Number (R) are not directly observable. Instead, a variety of independently produced models are used to interpret the data and estimate R.
² Different nations and regions may use different sets of models for these estimates; hence caution should be applied in drawing direct comparisons. For example, fewer models produce estimates for Wales and Northern Ireland.
³ The number of new infections per day.
⁴ These estimates can be subject to revision as further information is available and modelled.
Growth rate and reproduction number

5. For small daily changes, the growth rate is approximately the proportion by which the number of infections increases or decreases per day, that is, the speed at which an epidemic is growing or shrinking.\(^5\)

6. EMRG’s consensus estimates for the growth rates in the 4 nations are (90% credible interval):

   - England is between -1% to +1% per day,
   - Scotland is between +1% to +5% per day,
   - Wales is between -1% to +3% per day, and
   - Northern Ireland is between -2% to +1% per day

National and regional estimates of growth rates are summarised in Figure 1 and Figure 2.

7. The reproduction number (R) is the average number of secondary infections produced by a single infected individual; it is an average over time, geographies, viral variants, and communities.

8. UKHSA’s best estimate for R in England is between 0.9 and 1.1. R is estimated to be between 1.0 and 1.3 for Scotland, 1.0 and 1.2 for Wales, and 0.8 and 1.1 for Northern Ireland. UKHSA’s agreed national estimates are summarised in Table 1 and Figure 1, and these are based on the latest data available up to 13 September 2021\(^6\).

9. R is an indicator that lags by two to three weeks\(^7\), due to the time required for changes to be seen in data streams.

10. This inherent lag means that recent fluctuations should not be expected to be consistent with these estimates, and estimates may not represent transmission trends now.

11. This week, UKHSA’s estimates of the range of R includes values above and below one, for England and all English regions. There is uncertainty in the status of the epidemic in England and its future trends.

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\(^5\) Further Technical Information on the growth rate can be found in Plus Magazine: [The growth rate of COVID-19](https://plus.maths.org).

\(^6\) Different models fit to different windows of time using different methodologies, hence not all models will fit up to this precise date.

\(^7\) Different data-streams and different models are expected to be lagged in their estimates by different amounts when compared with the true underlying epidemiological situation. This is due to multiple lags such as reporting and delays in the infection processes. However, the consensus combination generally reflects a 2-week lag.
Table 1. Combined estimates of R values growth rates and doubling times in the 4 nations of the UK and NHS England regions (90% credible interval)

<table>
<thead>
<tr>
<th>Nation</th>
<th>R</th>
<th>Daily growth rate</th>
<th>Doubling time (^8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>0.9 to 1.1</td>
<td>-1% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>Wales</td>
<td>1.0 to 1.2</td>
<td>-1% to +3%</td>
<td>29 days to flat</td>
</tr>
<tr>
<td>Scotland</td>
<td>1.0 to 1.3</td>
<td>+1% to +5%</td>
<td>17 days to flat</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>0.8 to 1.1</td>
<td>-2% to +1%</td>
<td>-37 days to flat</td>
</tr>
<tr>
<td><strong>NHS England region</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>London</td>
<td>0.9 to 1.1</td>
<td>-1% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>East of England</td>
<td>0.9 to 1.1</td>
<td>-2% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>Midlands</td>
<td>0.9 to 1.1</td>
<td>-1% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>North East and Yorkshire</td>
<td>0.9 to 1.1</td>
<td>0% to +2%</td>
<td>Flat</td>
</tr>
<tr>
<td>North West</td>
<td>0.9 to 1.1</td>
<td>-1% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>South East</td>
<td>0.9 to 1.2</td>
<td>-1% to +1%</td>
<td>Flat</td>
</tr>
<tr>
<td>South West</td>
<td>0.9 to 1.1</td>
<td>-3% to +1%</td>
<td>-34 days to flat</td>
</tr>
</tbody>
</table>

\(^8\) Any estimates with a halving or doubling time of more than 40 days have been described as flat. Negative values of doubling time indicate a halving time (the time expected for cases to fall by 50%). Doubling time here is calculated using the growth rate.
Annexe A. PHIA framework of language for discussing probabilities

The Yardstick splits the probability scale into 7 ranges from remote chance (0 to 5% probability) to almost certain (95% to 100% probability).
Acknowledgements

UKHSA takes responsibility for this consensus statement and its contents. However, UKHSA would like to acknowledge the work of SPI-M-O and academic partners in developing methodologies and sharing these, as well as continuing to contribute model outputs to the combined estimates. These estimates include contribution from LSHTM (1, 2), Imperial College London (3, 8), University of Warwick (4, 5), University of Exeter and University of Bristol (6), Lancaster University (7), University of Manchester, Public Health England and University of Cambridge (9). UKHSA would also like to thank the European Bioinformatics Institute (10), University of Oxford (11, 12), University of Liverpool (13), and the Institute of Disease Modeling (14) for contributing model outputs. UKHSA also acknowledges the work developing combination estimates from Defence and Science Technology Laboratory (15). UKHSA also thanks and acknowledges the support and collaboration of the SPI-M-O Secretariat and co-Chairs, as well as colleagues across the 4 nations.

References

1. Abbott, Hellewell and others. 'Estimating the time-varying reproduction number of SARS-CoV-2 using national and subnational case counts'. Wellcome Open Research, 8 December 2020
2. Sherratt and others. 'National and Subnational estimates for the United Kingdom'
4. Keeling and others. 'Predictions of COVID-19 dynamics in the UK: Short-term forecasting and analysis of potential exit strategies. PLOS Computational Biology, 22 January 2021
6. Challen and others. 'Estimates of regional infectivity of COVID-19 in the United Kingdom following imposition of social distancing measures.' Philosophical Transactions of the Royal Society B: 31 May 2021
8. Cori and others. 'A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics.' American Journal of Epidemiology: 1 November 2013
9. Birrell and others. 'Real-time Nowcasting and Forecasting of COVID-19 Dynamics in England: the first wave?' Philosophical Transactions of the Royal Society B: Biological Sciences, 31 May 2021


15. Maishman and others. ‘Statistical methods used to combine the effective reproduction number, R(t), and other related measures of COVID-19 in the UK.’ arXiv preprint, 3 March 2021
Figure 1a. Estimates of R in the 4 nations of the UK (90% credible intervals). Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

**England**

**Scotland**
Figure 2b. Estimates of R in the 4 nations of the UK (90% credible intervals). Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

**Wales**

**Northern Ireland**
Figure 2a. Estimates of the growth rate in NHS England nations, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to the nearest percent.

**England**

![Graph showing growth rate estimates for England](image)

**Scotland**

![Graph showing growth rate estimates for Scotland](image)
Figure 2b. Estimates of the growth rate in NHS England nations, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to the nearest percent.

Wales

Northern Ireland
Figure 3a. Estimates of R in the NHS England regions, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

**London**

**East of England**
Figure 3b. Estimates of R in the NHS England regions, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

Midlands

North East and Yorkshire
Figure 3c. Estimates of R in the NHS England regions, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

**North West**

**South East**
Figure 3d. Estimates of $R$ in the NHS England regions, including 90% credible intervals. Bars represent different independent estimates. The grey shaded areas represent the combined numerical range and the black bars are the combined range after rounding outwards to 1 decimal place.

**South West**
About the UK Health Security Agency

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UKHSA Website: https://www.gov.uk/government/organisations/uk-health-security-agency

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